exhaustive and yet lucid and interesting from beginning to end. After reading it one feels that the Deinocerata are no longer extinct, vanished forms, but familiar acquaintances which one could not fail to recognise anywhere. Every part of their structure is methodically presented to view, and restorations are given showing the relations of the parts to each other and what is the author's conception of the general form of the animals. It has hardly ever been possible in the Old World to reconstruct the mammalia of so early a period from such ample materials as are now amassed at Yale College. Hence the restorations attempted have often been little more than more or less probable conjectures which might be conformed but were more usually corrected or even effaced by the progress of discovery. So full, however, is the evidence for Prof. Marsh's restorations, that there remains very little room for future emendation. He is still engaged in continuing these remarkable memoirs on the ancient life of the North American continent. A third monograph on the *Sauropoda* is approaching completion, and a fourth, on the *Stegosauria*, is far advanced. These large and profusely illustrated works are issued as part of the work of the United States Geological Survey. They reflect the highest honour on their indefatigable author, and on the Survey which undertakes their publication.

ARCH. GEIKIE

REMSEN'S "ORGANIC CHEMISTRY"

An Introduction to the Study of the Compounds of Carbon; or, Organic Chemistry. By Ira Remsen, Professor of Chemistry in the Johns Hopkins University. Pp. x., 364. (Boston: Ginn, Heath, and Co., 1885.)

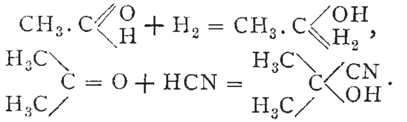
THIS is chemistry. Of how few books professing to be books on chemistry can it be said that they teach us anything of the science. The student who begins the study of the carbon compounds has to suffer many things from the text-books. Some of them present him with dry bones in the shape of isolated facts and bold assertions regarding structural formulæ and the linking of atoms. Others lead him into speculations which he is unprepared to follow; he makes little flights into these and comes back fancying he is a chemist. Other books (there are not many of them) proceed on the true scientific lines; but very frequently their pages are encumbered with too many facts about more or less widely separated compounds, or they deal so much with groups of compounds, rather than with typical individual bodies, that the beginner soon loses his way, becomes perplexed, and is ready to abandon the pursuit.

Prof. Remsen has shown us a more excellent way than any of these. He leads the learner by degrees through the early difficulties; he places before him distinct and detailed accounts of a few typical compounds; he shows him how these compounds are mutually related; and then he takes him back to the beginning again and teaches him how each compound he has learned to know represents a group, and how, when he knows the properties of one member of the group he also knows much about all the members.

At the outset Prof. Remsen makes a few wise and pregnant remarks on the meaning of structural formulæ. These "enable the chemist who *understands* the language in which they are written to see relations which might easily escape his attention without their aid. In order to *understand* them, however, the student must have a knowledge of the reactions upon which they are based; and he is warned not to accept any chemical formula unless he can see the reasons for accepting it." The whole book is a practical sermon on this text.

In no other elementary book in the English language will the student find so many admirably chosen examples of the formation of structural formulæ. The important facts are noted; then the inference is drawn; then the hypothesis is ventured upon; analogous facts are recalled; the hypothesis is strengthened or weakened; suggestions are made; experiments are conducted; and all is finally summarised in the formula. But the book is more than a selection of examples showing how structural formulæ ought to be gained. It is a systematic although elementary treatise on organic chemistry. The student is first taught about the two paraffins, methane and ethane; then he learns how the halogen derivatives of these are prepared, and what relations they bear to the parent hydrocarbons. By this time he has had his first taste of isomerism. Then he proceeds to the oxygen derivatives of methane and ethane; he learns what an alcohol is; he becomes acquainted with ether, aldehyde, formic and acetic acids, some ethereal salts, and acetone. This method of studying a few simple compounds in detail is pursued until the student is more or less familiar with representatives of all the principal groups of compounds derived from the paraffins. He is now in a position to study these hydrocarbons as a group, and to deal in some detail with the questions of isomerism. When the paraffins and their derivatives have been thus studied, the more difficult subject of the benzenes and their compounds is approached. And here the author shows an admirable power of dealing with facts as facts, and with theories as theories. What could be better than the following remarks regarding saturated and unsaturated compounds?

"In the aldehydes and ketones, carbon is in combination with oxygen in the carbonyl condition. When they unite with hydrogen and some compounds, such as hydrocyanic acid, the relation between the carbon and oxygen is probably changed, the latter being in the hydroxyl condition. The changes are usually represented by formulas such as the following:—



$$CH_3.C\begin{matrix}/\!\!/ O \\ \backslash H\end{matrix} + H_2 = CH_3.C\begin{matrix}/ OH \\ \backslash\!\!\backslash H_2\end{matrix},$$

$$\begin{matrix}H_3C\backslash \\ H_3C/\end{matrix}C = O + HCN = \begin{matrix}H_3C\backslash \\ H_3C/\end{matrix}C\begin{matrix}/ CN \\ \backslash OH\end{matrix}.$$

In the carbonyl group the oxygen is represented as held by two bonds to the carbon atom, while in the hydroxyl condition it is represented as held by one bond. The signs may be used if care is taken to avoid a too literal interpretation of them. There are undoubtedly two relations which carbon and oxygen bear to each other in carbon compounds. These relations may be called *the hydroxyl relation*, represented by the sign C—O—, and *the carbonyl relation*, represented by the sign C=O" (pp. 209–10).

How different this is to the crude, glaring statements that annoy the reader of the commonplace text-book written by the Philistine.

The fact that structural formulæ help us to understand the relations existing between the parts of specified mole-

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cules is strongly insisted on throughout this book. When we know nothing of these relations the author does not hesitate to tell us so. Thus, regarding the formula of benzene, as commonly written with successive double and single bonds, he says (p. 239):—"This formula, however, expresses something about which we know nothing, and concerning which it is difficult at present to form any conception. The simpler formula [*i.e.* the hexagon without any double bonds] leaves the question as to the relation between the carbon atoms entirely open, as it is in fact." And again, speaking of the structure of the molecule of ethylene, Prof. Remsen remarks (p. 213):—"As regards the relations between the two carbon atoms of ethylene we know nothing, save that it is probably different from that which exists between the carbon atoms of ethane."

A most instructive example of the methods pursued in organic chemistry, and at the same time of the scientific method of inquiry, is to be found on pp. 318–321, where the reactions of phenol-phthaleïn are discussed. The facts are given, but they seem only facts until some light is shed on them by the appearance in one reaction of triphenylmethane, a substance already familiar to the student. The student is shown how "this suggests that all the substances [he has been examining] are derivatives of this fundamental hydrocarbon." And he is asked to note how easily, when this conception has once been formed, the interpretation of all the reactions follows.

Many other admirable illustrations of the scientific method of inquiry are to be found throughout the book. I would especially draw attention to the simple but thoroughgoing treatment of the "equivalency of the hydrogen atoms" in the molecule CH_4 (pp. 28–29), and in the molecule C_6H_6 (pp. 234–236). It is on subjects such as are discussed in the pages referred to that the chemical student so frequently suffers shipwreck. If he will use this little book by Prof. Remsen as his pilot, and will keep a good look out as he proceeds, he may hope to pass the shoals of the hexagon-formula, and the shallows of the ortho-, meta-, and para-derivatives of benzene.

The author of this book deserves the thanks of all chemical teachers who have tried to teach organic chemistry to beginners for the clear and short directions which he gives for preparing the more important compounds of carbon. The book may well be used as a laboratory guide, no less than as an introduction to the science of organic chemistry.

Prof. Remsen has already done good service to the science of which he is a student, by publishing his "Principles of Theoretical Chemistry;" he has now given us a book which must be of great use in advancing the study of organic chemistry; could he not supplement these by an elementary but scientific treatise on inorganic chemistry?

M. M. PATTISON MUIR

MINERALOGY IN CALIFORNIA

Fourth Annual Report of the State Mineralogist of California. By H. G. Hanks. 8vo, pp. 410. (Sacramento: State Printer.)

ALTHOUGH a systematic geological investigation of the State of California has been commenced at different times since 1853, the Legislature has generally got tired of providing the funds after a few years' continuance, and the work has been stopped. The most notable effort towards the provision of a complete geological description of the State was that made by Prof. J. D. Whitney, who, with a body of assistants, including men of the highest attainments in every collateral branch of natural science, carried on the survey from 1860 to 1873, when it was suddenly discontinued, to the great regret of scientific men both in America and Europe. No attempt to continue or supplement Prof. Whitney's work was made until 1880, when the author was appointed State mineralogist with the object of investigating questions more particularly connected with mining industry than with geology in the larger sense. The author during his period of office, which appears to be terminable and held for four years only, has founded a valuable mineral museum and library, more than 6000 specimens illustrative of the mineral deposits of the State having been collected and arranged. These do not, however, appear to be very sumptuously housed, as the author calls attention to the danger from fire, "as well as other inconveniences, such as the prevalence of ammoniacal and hippuric odours, and the disturbance of arranged specimens in the cases by the jarring made by the hoisting of hay by tackles attached to the underside of the museum floor. The California State Museum is well worthy of a good and thoroughly fireproof building." With the latter opinion our readers will no doubt heartily agree.

Besides the work of organising the museum the author has published annually a report upon some branch of mineral industry as carried out in the State—for instance, that for 1883 was largely devoted to the borax deposits of the mud lakes in the interior of the State. The present volume, described as the fourth and last report of the State mineralogist, is mainly devoted to a catalogue and description of the minerals of California as far as they are yet known. This is alphabetically arranged, and contains descriptions of the composition physical properties and uses of the different species, together with detailed information as to localities, and methods of working in the more important ones. Altogether 161 different species are described as having been found in California, but this number will no doubt be considerably increased by future explorers. At the present time, in addition to gold; mercury, petroleum, and borax are the chief products of importance, although as regards all of them the prevailing complaints of over-production and unremunerative prices appear to be as prevalent as in less favoured localities in the Old World. The condition of the gold-mining industry appears to be a very healthy one, for although the enormous annual yield, ranging from 10 to 13 millions sterling in 1850–55, has diminished to 3 and 4½ millions in the past four years; the increased facilities for working render it possible to handle at a profit rock not containing more than 12*s.* worth of gold in the ton; while in the earlier days 20 dollar (80*s.*) rock was not considered to be worth removal. The total value of the gold raised in California since 1848 is estimated at above 230,000,000*l.* in value, which if reduced to a single mass would be contained in a cube 14 feet 4 inches in the side.

Although the work is essentially a compilation, it is well arranged, and will be of great use to those interested in Californian minerals. A general introduction on the

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